FIRST FIVE-YEAR REVIEW REPORT
GLOBAL SANITARY LANDFILL SUPERFUND SITE
OLD BRIDGE TOWNSHIP, MIDDLESEX COUNTY, NEW JERSEY

Prepared by

U.S. Environmental Protection Agency
Region 2
New York, New York

July 2015

Approved by:

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Date: July 20, 2015

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Executive Summary

This is the first five-year review for the Global Sanitary Landfill Superfund site located in Old Bridge Township, Middlesex County, New Jersey. The site is being addressed in two operable units. Operable Unit 1 (OU1) addresses: slope stabilization; landfill capping; gas, storm water and leachate management; perimeter security fence; and implementation of a monitoring program. Operable Unit 2 (OU2) addresses contaminant migration from the landfill into groundwater, surface water, sediment, soil and wetlands. The purpose of this five-year review is to review information to determine if the remedy is and will continue to be protective of human health and the environment. The triggering action for this statutory five-year review is the on-site construction start date of the OU1 remedial action, which was August 2010.

The remedy at OU1 is protective of human health and the environment. The remedy at OU2 currently protects human health and the environment because all human and ecological exposure routes have been addressed. However, in order for the remedy to be protective in the long-term, the trends from additional rounds of data will need to be evaluated to ensure that the groundwater contamination in the lower water zone aquifer (LWZ) is responding to natural attenuation as expected with the completion of the cap construction.

Five-Year Review Summary Form

SITE IDENTIFICATION		
Site Name: Global Sanitary Landfill		
EPA ID: **NJDO63160667**		
Region 2	**State:** NJ	**City/County:** Old Bridge / Middlesex

SITE STATUS	
NPL Status: Final	
Multiple OUs? Yes	**Has the site achieved construction completion?** Yes

REVIEW STATUS
Lead agency: State
Author name (Federal or State Project Manager): Edward J. Finnerty
Author affiliation: U.S. EPA Region 2
Review period: August 2010 - 01/15/2015
Date of site inspection: 11/24/2014
Type of review: Statutory
Review number: 1
Triggering action date: 8/1/2010
Due date *(five years after triggering action date)* : 8/1/2015

Issues/Recommendations

OU(s) without Issues/Recommendations Identified in the Five-Year Review:
OU1
Issues and Recommendations Identified in the Five-Year Review:

OU(s): *OU2*	**Issue Category: Monitoring**
	Issue: Since the OU1 remedy was only completed in 2012, not enough groundwater monitoring data collection has been completed to establish post-remedy construction completion contaminated groundwater trends.

	Recommendation: Continue groundwater monitoring			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	No	PRP	State	6/1/2020

Protectiveness Statement(s)		
Operable Unit: 1	*Protectiveness Determination:* Protective	*Addendum Due Date (if applicable):*Click here to enter a date.
Protectiveness Statement: The remedy at OU1 is protective of human health and the environment.		

Protectiveness Statement(s)		
Operable Unit: 2	*Protectiveness Determination:* Short-term Protective	*Addendum Due Date (if applicable):*Click here to enter a date.
The remedy at OU2 currently protects human health and the environment because all human and ecological exposure routes have been addressed. However, in order for the remedy to be protective in the long-term, trends developed from additional rounds of groundwater sampling data will need to be evaluated to ensure that the groundwater contamination is responding to natural attenuation as expected with the completion of the landfill cap construction.		

Sitewide Protectiveness Statement	
Protectiveness Determination: Short-term Protective	*Addendum Due Date (if applicable):* Click here to enter a date.
The remedy at the site is protective of human health and the environment in the short-term because all human and ecological exposure routes have been addressed. However, in order for the remedy to be protective in the long-term, trends developed from additional rounds of groundwater sampling data will need to be evaluated to ensure that the groundwater contamination is responding to natural attenuation as expected with the completion of the landfill cap construction.	

Introduction

The purpose of a five-year review is to evaluate the implementation and performance of a remedy in order to determine if the remedy is and will continue to be protective of human health and the environment and is functioning as intended by the decision documents. The methods, findings, and conclusions of reviews are documented in the five-year review. In addition, five-year review reports identify issues found during the review, if any, and document recommendations to address them.

This is the first five-year review for the Global Sanitary Landfill site, located in Old Bridge Township, Middlesex County, New Jersey. This five-year review was conducted by the United States Environmental Protection Agency (EPA) Remedial Project Manager (RPM) Edward Finnerty. The review was conducted pursuant to Section 121(c) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended, 42 U.S.C. §9601 *et seq.* and 40 CFR 300.430(f)(4)(ii), in accordance with the *Comprehensive Five-Year Review Guidance*, OSWER Directive 9355.7-03B-P (June 2001). This report will become part of the site file.

The triggering action for this statutory review is the on-site construction start date of the OU1 remedial action. A five-year review is required at this site due to the fact that hazardous substances, pollutants or contaminants remain at the site above levels that allow for unlimited use and unrestricted exposure. The site consists of two operable units, both of which are addressed in this five-year review.

Site Chronology

See Table 1 for the site chronology.

Background

Physical Characteristics

The site is primarily bordered by wetlands in the drainage basin of Cheesequake Creek. Cheesequake Creek is located approximately 900 feet southeast of the landfill, drains to the northeast, and enters the Raritan Bay approximately 9,000 feet northeast of the site. On the opposite side of the creek from the site is Cheesequake State Park. The Garden State Parkway is located approximately 2,700 feet east-northeast of the landfill. A former sand borrow pit is located to the northwest.

The northeastern property line of the site is also the municipal boundary between Old Bridge Township and the Borough of Sayreville. Residential areas of Old Bridge Township and the Borough of Sayreville are located north and west-northwest of the site. These areas include several apartment complexes approximately 900 and 2,400 feet from the site that existed during landfill operations, with the intervening area consisting of the above-mentioned borrow pit and a wooded area. A development of single-family homes was subsequently constructed in Sayreville approximately 200 feet north of the landfill. These homes were constructed several years after the Records of Decision (RODs) for the site were issued by EPA.

Site Geology/Hydrogeology

The site is located in the New Jersey Coastal Plain, which includes Cretaceous and Quaternary sediments primarily comprised of clay, silt, sand, and gravel, and are classified as continental, coastal, or marine type deposits. The near-surface Quaternary deposits, where present, are essentially flat-lying. The Cretaceous deposits in the vicinity of the site are reported to generally strike northeast-southwest and to dip gently to the southeast 10 to 60 feet/mile, and to thicken seaward from a thin veneer at the fall line, which separates the Coastal Plain from the higher Piedmont Plateau. Depths to bedrock in the area of the site are more than several hundred feet.

The silty medium to fine sand layer constituting the upper water-bearing zone (UWZ) is directly underlain by the Old Bridge Sand formation. In general, water quality in the UWZ is naturally non-potable due to the influence of the saline Cheesequake Creek and is classified as III-B by the New Jersey Department of Environmental Protection (NJDEP). Beneath the main landfill mound and a portion of the northwest extension area, the UWZ is separated by a confining layer from the Old Bridge Sand aquifer, which is the LWZ under the site. Currently, local portions of the LWZ are classified by NJDEP as III-B and is non-potable. The confining layer consists of a 25-35 foot thick clay layer identified to be the Amboy Stoneware member of the Raritan formation. The general direction of the groundwater flow for both the UWZ and LWZ is to the south-southeast.

Land and Resource Use

The site is approximately 60 acres in size. The northeastern property line is also the municipal boundary between Old Bridge Township and the Borough of Sayreville. The site is bordered by wetlands to the northeast, southeast, and southwest, in the drainage basin of Cheesequake Creek. Cheesequake Creek is located approximately 900 feet southeast. Residential areas of Old Bridge Township and the Borough of Sayreville are north and west-northwest of the site, respectively, and include several apartment complexes, as well as single-family homes, located off of Westminster Boulevard and Ernston Road.

History of Contamination

Global Landfill Reclaiming Corporation operated the landfill from approximately 1968 to 1984. In 1984, a slope failure occurred that was attributed to rapid filling of waste followed by periods of heavy rain and unusually high tides. Since April 27, 1984, when the NJDEP ordered the disposal operations to cease, the landfill has remained inactive, but has been the subject of various investigations and interim remediation measures. During the late 1980s and 1990s, NJDEP and EPA conducted pollution containment activities, as well as soil, water and wetlands investigations and monitoring. This is a state-lead enforcement site cleanup. NJDEP is the lead agency and EPA is the support agency.

Initial Response

The NJDEP ordered Global Landfill Reclaiming Corporation to cease operations in 1984 after a landfill side-slope failure destroyed several acres of adjacent wetlands. In 1989, the site was placed on the EPA National Priorities List because of the presence of contaminated leachate and the discovery of buried drums containing hazardous waste in a portion of the landfill (40 Code of Federal Regulations, Part 300, Volume 54, Number 61, March 31, 1989).

Basis for Taking Action

In 1984, the Global Sanitary Landfill suffered a serious slope failure. Between 1991 and 1996,

NJDEP conducted a remedial investigation/feasibility study (RI/FS) to evaluate the nature and extent of the contamination at the site. The RI/FS revealed that shallow groundwater at the site was contaminated with organic compounds, pesticides and metals and the deeper groundwater was contaminated with inorganic and organic contaminants. In accordance with CERCLA guidance on municipal landfills, (Conducting Remedial Investigations/Feasibility Studies For CERCLA Municipal Landfill Sites, February 1991, OSWER Directive 9355.3-11), where established standards for one or more contaminants in a given medium are clearly exceeded, the basis for taking remedial action is warranted. The inorganic contaminants cadmium, chromium and lead, and volatile organic contaminants chlorobenzene, benzene, and vinyl chloride were all detected in excess of drinking water criteria, EPA's Maximum Contaminant Levels (MCLs). In addition, the presence of buried drums containing hazardous substances was identified. An ecological study of the wetland areas showed that the sediments near a landfill seep were adversely affecting certain native aquatic organisms. This impact was attributed to ammonia discharging from the landfill. A risk assessment based on the findings of the RI/FS indicated that while the conditions at the site did not pose a threat to human health, the contaminated sediments in the immediate area of the landfill seep might likely pose a threat to the environment.

Remedial Actions

Remedy Selection

Operable Unit 1 - Following the listing of the site, the potentially responsible parties (the "PRP Group") were authorized by NJDEP to prepare a feasibility study (FS) to evaluate alternatives for on-site controls at the site prior to completion of the RI/FS. The Proposed Plan and FS were released for public comment on February 19, 1991. On September 11, 1991, EPA issued a Record of Decision (ROD) for OU1 remedial action (RA) addressing on-site controls. The remedial action objective (RAO) identified in the OU1 ROD is to contain contaminants at the site and limit exposure to levels protective of human health and the environment.

The major components of the selected OU1 remedy include:

- •Capping of the landfill;
- •Slope stabilization;
- •Gas, storm water and leachate management;
- •Perimeter security fence; and,
- •Implementation of a monitoring program.

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Operable Unit 2 - The OU2 ROD addresses contaminant migration from the landfill into groundwater, surface water, sediment, and soil. An RI/FS was initiated in March 1991 by URS Consultants, the PRP Group consultants, and completed in December 1996. Studies showed that shallow groundwater beneath the site is contaminated with volatile and semi-volatile organic compounds, pesticides and metals. However, shallow groundwater is non-potable (NJDEP Class III-B) due to natural conditions unrelated to the landfill (salt-water influence of the tidal Cheesequake Creek). Also, impacts to the wetlands were limited to a small area (about ¼-acre) bordering a portion of the landfill. There are no public wells in the vicinity of the landfill. On September 29, 1997, EPA signed the OU2 ROD. The landfill posed a threat related to leaching of contaminants from the landfill into the UWZ and LWZ. Table 1 compares UWZ and LWZ contaminants to New Jersey Groundwater Quality Standards (GWQS). The landfill also posed a threat to the neighboring wetlands when leached contaminants were transported to the wetlands surface water and sediments. The specific remedial action objectives identified in the ROD are:

- Protect the potable Old Bridge Sand aquifer (LWZ) from contamination present in the UWZ;
- Protect the wetlands from contamination present in the UWZ; and,
- Prevent adverse ecological impacts from contaminated wetland sediments.

The above objectives were addressed in part by the remedial actions selected in the OU1 ROD (a landfill cap, and a leachate collection and treatment system for OU1).

The major components of the OU2 selected remedy include the following:

- Quarterly testing of new and existing on-site wells to monitor the extent of natural attenuation of contaminants in the UWZ and the LWZ;
- Annual reviews to evaluate the effectiveness of the selected ground-water remedy;
- Placement of a Classification Exception Area (CEA) which would also act as a Well Restriction Area (WRA) for both the UWZ and the LWZ in areas where contaminants were detected;
- Localized removal of contaminated wetland sediments from the southeastern portion of the site;
- Placement of these sediments on top of the landfill before it is capped;
- Annual ecological monitoring for five years after operable units one and two are implemented; and
- Five-year reviews of the site pursuant to CERCLA and to determine whether any further action is needed to protect groundwater quality.

Remedy Implementation

OU1 Landfill Cap

In 1993, the State of New Jersey and approximately 29 companies signed a Consent Decree (CD) which required the companies to implement the OU1 remedy. Work was initiated by the PRP Group with the submittal of a remedial action work plan (RAWP) in February 1994. Concurrently, in order to evaluate the site conditions which could affect the components of the OU1 remedy, a pre-design investigation (PDI) was performed and a PDI report was submitted in December 1994. Following the recommendations in the PDI report, the PRP Group initiated the early implementation of the first phase of the OU1 remedy with the installation of geotechnical monitoring instruments in the fall of 1996 and the placement of approximately 25,000 cubic yards of grading fill on the top of the main landfill during the summer of 1997. This grading fill was placed on the landfill in order to crown the landfill and provide an engineered fill base to support the final cap on the top of the landfill. Furthermore, geotechnical monitoring provided information on how placing fill on the landfill might affect landfill settlement and slope stability. In 2001, a revised PDI report updated analyses conducted in the 1994 PDI report based on the geotechnical monitoring conducted during and after grading fill placement. A major conclusion of the 2001 revised PDI was that an alternate cap construction will provide equivalent or superior performance to the ROD cap, as described further below, and would be more protective of landfill slope stability. The United States Army Corps of Engineers (USACE) in their role as

technical support to the EPA, conducted independent slope analyses in order to confirm the conclusions of the 2001 revised PDI Report. The USACE concurred with the approach for slope stability analyses during the remedial design (RD) of the site leading to submittal of the conceptual design report (CDR) (August, 2003).

Monitoring of the surcharge continued following completion of the preload to provide data for the final design of the OU1 remedy. Based on this geotechnical monitoring, the CDR, and final revised RAWP (2005), a recommendation was made for an intermediate construction step prior to placement of the landfill cap that involved the placement of preload and surcharge fill. Initiation of the preload fill activities began in November 2005 and was completed in January 2006. The preload was constructed in advance of the placement of the final cap and the landfill gas management system and maintained for approximately one year so as to avoid damage to the final remedy as a result of post-construction settlement, and to maintain a 3% drainage grade. Accordingly, approximately 75,000 cubic yards of fill were placed on the landfill crown during November and December of 2005.

State comments to the CDR (2003) were subsequently addressed in the May 2005 final revised RAWP and an addendum to the May 2005 RAWP dated January 25, 2006. The final RAWP prepared by Golder Associates, Inc. (Golder), presents the components of the proposed alternate cap. On August 15, 2006, EPA issued an Explanation of Significant Differences (ESD) to explain the modifications made to the OU1 ROD cap. The ESD modified the materials and thickness of materials used for the landfill cover to provide for a lighter, more stable landfill cap than the one selected in the OU1 ROD. These components are compared below with the components of the modified NJDEP Hazardous Waste Cap included in the OU1 ROD.

ROD Cap	Alternate Cap (selected in the ESD)
• 1-foot vegetated layer	• 6-inch vegetated layer
• 1-foot drainage layer	• 12-inch cover soil
• Geomembrane	• Geocomposite drainage layer
• 1-foot compacted clay	• Geomembrane
• Grading fill as necessary	• Geosynthetic clay layer (landfill crown and northwest extension only)
	• Grading fill as necessary

Monitoring the success of the preload fill and development of a draft revised CD occurred in 2006 and 2007. In 2008, the PRP Group modified the CD to incorporate changes to the remedy and include OU2 provisions. In addition, obtaining access agreements and permit equivalencies, and the purchase of fill material was conducted in 2008 through 2010

Landfill remedy construction began in the summer of 2010 with the construction of a landfill gas management trench and venting system. This work was performed by WRS Compass under the management and oversight of the PRP Group and NJDEP. Fill materials used for cap construction were also delivered and stockpiled in approved areas at the site, until winter conditions caused a hiatus in the construction activities.

The PRP Group awarded a second construction contract in October 2010 to CETCO Contracting Services, Co. (CETCO), for construction of the landfill cap and other remedy components. This work was completed in August 2012. CETCO's work was managed by the PRP Group in

coordination with NJDEP oversight. Beginning in the winter of 2010, CETCO placed approximately 150,000 cubic yards of stockpiled fill material to grade the top of the landfill in preparation for installation of the geosynthetic components of the cap (low permeability geomembrane and leachate collection drainage layers). In order to contour the site so that rainwater would more readily run off the cap, grading fill was placed over approximately 95% of the landfill surface. Five leachate collection blankets were constructed to intercept leachate that previously flowed from the slopes into a portion of the wetlands at the landfill perimeter. Leachate pump stations and conveyance piping installation commenced operation in the fall 2011. Leachate collection tanks and an equipment building followed in the winter 2011- spring 2012 period. Leachate collected by the system is transported by tanker truck for disposal at an off-site treatment facility certified to handle CERCLA waste. In conformance with NJDEP air quality discharge requirements 27 deep gas wells have been installed through the waste in conjunction with 27 shallow gas vents installed just below the grading fill layer in order to manage the landfill gas that will be trapped beneath the geomembrane cover. Fifteen additional gas vents were installed during the spring and/summer of 2012 in order to complete the gas management system.

The final cover utilized one of two different landfill cap sections. Cap Type 1 consists of the following items (listed from the top down):

- 6-inch thick vegetative support layer (topsoil);
- 12-inch thick soil cover layer;
- Single-sided geocomposite drainage layer fabricated by SKAPS Industries;
- Textured 40-mil linear low density polyethylene (LLDPE) MicroSpike® geomembrane manufactured by Agru America;
- Bentomat® geosynthetic clay liner (GCL) manufactured by CETCO; and
- 12-inch (minimum) thick soil grading layer.

Cap Type I was installed on the flatter top ("crown") of the main landfill, and in the area designated as the Northwest Extension Area. In a select area of the crown, an additional geocomposite drainage layer was installed below the GCL to assist landfill gas conveyance to vents located in this area.

The second cap design section, Cap Type II, was installed on the side slopes of the landfill. Cap Type II consists of the following items (listed from the top down):

- 6-inch thick vegetative support layer (topsoil);
- 12-inch thick soil cover layer;
- Double-sided geocomposite drainage layer fabricated by SKAPS Industries;
- Textured 40-mil linear LLDPE Micro Spike® geomembrane manufactured by Agru America;
- 10 ounce per square yard non-woven, needle-punched geotextile (GEOTEX® 1071) manufactured by Propex Inc.; and
- 12-inch (minimum) thick soil grading layer.

The grading layer, which consisted predominantly of processed dredge material (PDM), was placed on regraded landfill material. The regraded landfill material consisted of relocated soil/waste excavated from areas of the landfill requiring cut to achieve subgrade elevations, the cleared landfill surface, or soil from the preload fill stockpile.

OU2 - Groundwater Monitoring, Wetland Sediments, Wetlands Mitigation

In 2008, the CD with the PRP Group was amended to include wetlands remediation and monitoring of the improvement of groundwater quality expected to occur after a low permeability cap is constructed on the landfill. In 2009 and 2010, the OU2 RD was completed, permit equivalencies were obtained including those required for wetlands mitigation, and fill materials were delivered and stockpiled at the site in preparation for construction of the cap and landfill gas management system

Groundwater Monitoring – A groundwater monitoring plan (GMP) was developed pursuant to the OU2 ROD and approved as a part of the 100% RD report. The primary objectives of the monitoring plan are to track groundwater quality in the UWZ along the perimeter of the landfill following placement of the cap; and, to monitor ground water quality and the natural attenuation of constituents in the LWZ. The GMP includes semi-annual monitoring of eight UWZ monitoring wells and eight LWZ monitoring wells. The effectiveness of the CEA in protecting human health and the environment will be evaluated by the PRP Group and evaluation of the monitoring results will be provided to NJDEP and EPA for approval every two years after completion of the remedy construction.

Localized Removal of Contaminated Wetland Sediments – The OU2 ROD required localized sediment excavation in the vicinity of a leachate seep area in the southeastern corner of the site. The OU2 ROD required that sediments be excavated to the limits and depths necessary to replace visibly stained and distressed vegetation with new soil and wetland vegetation. Sediment excavation was initiated on July 11, 2011, and completed on July 24, 2011. The final extent of the excavation and replacement of sediment in the sediment remediation area covered an area of approximately 17,000 square feet. Within this area, existing impacted sediments and associated surface vegetation were excavated to an average depth of approximately 22 inches below ground surface resulting in the removal of approximately 1,175 cubic yards of leachate-impacted material. The excavated material was transported from the sediment remediation area to the upland portion of the northwest extension area of the landfill. The sediments were spread below the geosynthetic components of the landfill cap. The sediment remediation area was subsequently backfilled with imported clean fill topsoil. Wetlands plants were installed on September 26, 2011, with the objective of restoring the area with native wetland vegetation.

Wetlands Mitigation – Site Inspection/Preliminary Assessment at the selected wetlands mitigation site (WMS) located 1.5 miles from the site was conducted in 2010. The PRP Group initiated removal and off-site disposal of debris and impacted surficial soil and restoration of the excavated area concurrent with wetland mitigation activities. All work was completed and is detailed in the December 21, 2011, *Remedial Action Report, Global Landfill Wetland Mitigation Site*. On February 28, 2011, the PRP Group contractor mobilized to the site to initiate wetlands mitigation construction preparation activities and commencement of wetland construction activities occurred in March 2011. The PRP Group contractor completed planting activities in July 2011 and a construction completion meeting was conducted by NJDEP in July 2011. On August 20, 2011, a pre-final inspection was held at the WMS and a post construction meeting was conducted with NJDEP in September 2011. The WMS construction is documented by a post-construction, record survey as presented and summarized in the *Annual Report for 2011, Global Landfill Wetland Mitigation Project* dated January 2012.

Summary - On August 20, 2012, EPA, NJDEP, the PRP Group representatives, and Golder, conducted the pre-final inspection at the site. The inspection included both the landfill and the

WMS. On August 31, 2012, NJDEP issued to the PRP Group a letter documenting the visit and acknowledging completion of construction of the landfill cap and all its components as well as the successful growth of vegetation at the WMS, thereby determining that the remedies have been constructed in accordance with the plans and specifications for the OU1 and OU2 RD.

Institutional Controls

Classification Exception Area (CEA) – The OU2 remedy relies on the use of institutional controls to protect against groundwater use in the UWZ and LWZ while the quality of groundwater improves as a result of implementing the OU1 remedy. CEAs approved by NJDEP in the final design report were formally submitted for completion 90 days after approval of the site OU1 and OU2 remedial action reports (RARs) (March 2012). Figure 2 illustrates the extent of the CEA. Effectiveness of the CEA will be certified by the PRP Group's contractor and will be submitted to NJDEP every two years after establishment. The CEA for both zones are currently based on groundwater data and modelling of a 1,4-dioxane plume. Although the extent of the 1,4-dioxane plume is not defined with monitoring well data, because the CEA is in place, the use of the groundwater in the vicinity of the site is highly unlikely.

Deed Notices – Although not formally selected in a decision document, NJDEP required establishment of deed notices and access agreements at the site to insure engineering controls are not impacted. Once in place, the maintenance of the deed notices will be verified by the PRP Group on a biennial basis and will generate a report that includes a review to ensure that activities on the properties have not modified or encroached on the engineering controls; that activities on the landfill during operation and maintenance (O&M) have not encroached onto properties outside the deed notice boundaries; and documenting generally that the condition of the engineered controls have been maintained.

System Operations/Operation and Maintenance

An Operation and Maintenance Plan (O&M Plan) for the site was developed to provide inspection, maintenance and reporting activities in connection with the following activities:

- Site security to include fences, building and access roads;
- Cover system and vegetation;
- Storm water management system;
- Leachate collection system and leachate disposal;
- Landfill gas monitoring, sampling and testing;
- Geotechnical instruments;
- Ecological monitoring; and
- Groundwater monitoring.

Potential site impacts from climate change have been assessed, and the performance of the remedy is currently not at risk due to the expected effects of climate change in the region and near the site. This assessment was based in part on the minor amount of damage sustained at the site due to Super Storm Sandy in October 2012.

Progress Since Last Five-Year Review

This is the first five-year review for this site.

Five-Year Review Process

Administrative Components

The five-year review team included Edward Finnerty EPA – RPM, Edward Modica EPA-Hydrogeologist, Abbey States EPA-Human Health Risk Assessor, Michael Clemetson EPA-Ecological Risk Assessor, and Wanda Ayala EPA-Community Involvement Coordinator. This is a State/PRP–enforcement lead site.

Community Involvement

The EPA Community Involvement Coordinator for the Global Sanitary Landfill site, Wanda Ayala, posted a notice on the EPA and Old Bridge Township websites on June 25, 2015, notifying the community of the initiation of the five-year review process. The notice indicated that EPA would be conducting a five-year review for the site to ensure that the implemented remedy remains protective of public health and the environment and is functioning as designed. Once the five-year review is completed, the results will be made available at the local site repository, which is at the Old Bridge Township Municipal Building.

The NJDEP's Bureau of Community Relations keeps the local public officials informed about progress at the site and the PRP's at the site have taken upon themselves the preparation and distribution of fact sheets they developed for the property owners closest to the site.

Document Review

The documents, data and information which were reviewed in completing this five-year review are summarized in Table 3.

Data Review

Groundwater Monitoring - As per the OU2 ROD, the objectives of the groundwater monitoring program are to track groundwater quality in the organic-rich meadow mat, referred to as the UWZ, along the perimeter of the landfill, and to monitor groundwater quality and natural attenuation of chemical constituents in the Old Bridge Sand aquifer, referred to as the LWZ. Monitoring is required in order to continually assess the protectiveness of the CEA on potential receptors.

Groundwater at the site is monitored on a semi-annual basis. The monitoring network consists of eight well pairs located along the perimeter of the landfill, each well screened in the UWZ and LWZ, respectively. Groundwater movement is to the south-southeast, and wells MW-7S, MW-7D and MW-13S (an LWZ well), located on the northwest side of the landfill, serve to monitor background groundwater conditions. Wells MW-8 (S&D) are located on the northeast side of the landfill, wells MW-3 (SR & A), MW-14 (S & D), and MW-4 (S & A) are on the southeastern border, wells MW-5 (S & AR) and MW-15 (S & D) are on the southwest border, and well MW-6S is located in the western corner of the landfill. Groundwater samples from both the UWZ and LWZ are analyzed for VOCs, SVOCs, and target analyte list compounds (TALs). Samples from the UWZ are also analyzed for PCBs and ammonia.

Water-quality date for this five-year review is based on analytical results from sampling events conducted in October 2012, March 2013, and October 2013. It should be noted that trend analyses were not conducted in this FYR due to the limited amount of data:

Upper Water-bearing Zone (UWZ) - VOCs were detected in all UWZ samples including those from background wells. Benzene and chlorobenzene were detected at or above GWQS at concentrations ranging from 7.4 micrograms per liter (µg/L) to 88 µg/L; and 61 µg/L to 2,000 µg/L respectively, in wells MW-5S, MW-8S, MW-14S, and MW15S; these results are consistent with historical data. 1,4-dioxane was detected above GWQS at concentrations ranging from 31 µg/L to 830 µg/L in all UWZ samples except MW3SR, MW-MW6S, and MW-7S.

Low levels of SVOCs were detected in all UWZ samples including those from background wells. Benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, bis(2-ethylhexyl)phthalate, 2-methylnaphthalene, and n-nitrosodiphenylamine, were detected in excess of GWQS in wells MW-3SR, MW-7S, MW-8S, and MW-15S. Concentrations ranged from 0.1 µg/L to 15 µg/L. Naphthalene was detected in MW-5S above GWQS (300 µg/L) at concentrations ranging from 1,400 µg/L to 2,100 µg/L. Naphthalene concentrations in MW-5S are markedly greater than other monitoring wells in the UWZ and concentrations reported for these recent sampling events are consistent with historical data. SVOCs were not detected above GWQS in wells MW-4S, MW-6S, MW-6S, and MW-14S.

The inorganics aluminum, arsenic, lead, iron, manganese, and sodium were detected above GWQS in all UWZ monitoring wells. Chromium and nickel were also detected above GWQS (70 µg/L and 100 µg/L, respectively) in MW-8S at concentrations ranging from 91 µg/L to 99 µg/L and 163 µg/L to 170 µg/L, respectively. Ammonia concentrations ranged from non-detect in MW-7S to 750 mg/L in MW-8S, with an average of about 200 mg/L. Concentrations of ammonia in the UWZ are generally lower than those reported for pre-construction monitoring.

Lower Water-bearing Zone (LWZ) - In general, low levels of VOCs were detected in wells screened in the LWZ as compared to levels observed in the UWZ, except for background well MW-13S. Benzene was detected in MW-3A, MW-8D, and MW-14D at concentrations of 2.4 µg/L or less, whereas tetrachloroethene was detected in MW-5AR, MW-7D, and MW-15D at concentrations of about 5 µg/L or less. Chlorobenzene was detected in replacement well MW-5AR at concentrations ranging from 140 µg/L to 160 µg/L, and are similar to historical data for this well. 1,4-dioxane was detected above GWQS in wells MW-3A, MW-5AR, MW-8D, and MW-14D at concentrations ranging from 11 µg/L to 110 µg/L. The occurrence of 1,4 dioxane in wells screened in the LWZ suggest that 1,4-dioxane may be migrating downward from the UWZ in the northern parts of the landfill where the intervening clay-silt unit between the two aquifer is absent. In addition, 1,4-dioxane is present in upgradient and down gradient wells in the LWZ. Groundwater samples will continue to evaluated for 1,4-dioxane to determine overall trends and ensure they are not increasing.

No detections of SVOCs were reported for well MW-5AR.

The inorganics aluminum, arsenic, beryllium, lead, chromium, iron, manganese, and sodium were detected above GWQS in all LWZ monitoring wells. Arsenic was detected in MW-4A and MW-14D at 21 µg/L and 9.2 µg/L. Beryllium was found in wells MW-4A, MW-5AR, and MW-15D at concentrations of 6.9 µg/L or less. Chromium was detected in wells MW-7D and MW-8D at concentrations of 170 µg/L or less.

Ecological Monitoring

Prior to remediation, baseline ecological monitoring was conducted October of 2012. The first

and second post-remedy data collection efforts were conducted in October of 2012 and September of 2013, respectively.

A network of five primary sampling locations, referred to as ECO-1 through ECO-5, was established adjacent to and within 100 feet of the landfill, on its eastern side near tributaries of the Cheesequake Creek. Location ECO-5 coincides with the sediment remediation area. Two reference locations, ECO-RF1 and ECO-RF2, located approximately a half mile east-northeast of the landfill, were also established in a marsh in Cheesequake State Park to evaluate conditions unrelated to the landfill.

The Ecological Monitoring Program (EMP) entails conducting a Visual Habitat Assessment of the wetlands surrounding the landfill at the designated sample locations and in the area of sediment restoration. The assessment involves a qualitative monitoring of the vigor of the wetland plant community and provides a means of identifying exposure to contamination.

The EMP also entails collecting sediment samples at the designated sample locations, which are analyzed for chemical constituents Target Compound List compounds (TALs), cyanide, ammonia, and total organic carbon (TOC), macro-invertebrates, and sediment grain-size. Samples collected from ECO-5 were also subject to bioassay testing. The analyses were necessary to determine whether concentrations of contaminants of concern (COCs) are bioavailable at levels that are toxic to aquatic invertebrates; the analyses are also used to evaluate the effectiveness of the remedy.

Results of Visual Habitat Assessment - The habitat of each sample location was visually assessed as part of the second post-remediation monitoring in October of 2013. In general, no indicators of landfill-related impacts were observed at the sample locations during assessment, neither were any significant changes in habitat observed in 2013, in comparison to assessments completed in previous years (2011 and 2012).

An initial habitat assessment of location ECO-5 was conducted in 2012 following excavation and restoration of the impacted sediment area (completed in 2011). The estimated percent vegetative cover was near 100% in the northern portion of the sediment restoration area, an indication that cover had been successfully established. However, the estimated percent vegetative cover in the southern portion of the restoration area was 9%; the lower vegetative cover in this area is attributed to coarser grained soil materials used to stabilize the area and to local drainage conditions. The assessment of the southern area in 2013 showed that vegetative cover increased to 42%, likely due to fill materials mixing with finer grain marsh sediments transported by tidal waters. It is anticipated that marsh vegetation will continue to re-populate the area over time with native species and that the sediment restoration area will remain stable, with no risk of erosion.

Results of Sediment Analysis - Estimated low levels of toluene were detected at all primary and reference sample locations in 2013. Toluene is not site-related as it was not detected at any locations in previous sampling events. Low concentrations of acetone were also reported in primary and duplicate samples taken in ECO-5. Likely, both compounds are laboratory artifacts.

Carbon disulfide was detected in samples collected in ECO-1 at a concentration of 9.7 µg/kg, in ECO-2 at 4.2 µg/kg, and in ECO-4 at 7.6 µg/kg during the 2013 sampling event. Low levels were also detected during the 2011 baseline and 2012 sampling events. Carbon disulfide is believed to occur naturally due to activity of microorganisms in marsh sediments.

Ammonia was detected in all primary and reference sample locations during the 2013 monitoring event; concentrations ranged from 7.29 milligrams per kilogram (mg/kg) in ECO-4 to 20.9 mg/kg in ECO-3. Results are similar to those from the 2012 and 2011 sampling events. Concentrations of 4.84 mg/kg and 14.9 mg/kg were also reported for reference locations ECO-RF1 and ECO-RF2, respectively; an indication that there is the potential for other sources of ammonia in the marsh that are not related to the landfill.

Inorganics were detected in all sediment samples. Concentrations of inorganics in reference samples were similar to those reported in samples collected near the landfill in both previous sampling events (2011 and 2012). Reference samples contained the highest detected concentrations of twelve of the metals analyzed, aluminum, antimony, arsenic, chromium, copper, lead, iron, magnesium, manganese, mercury, silver, sodium, and vanadium.

TOC was detected in all samples at concentrations ranging from 1.9% in ECO-5 to 22.7% in ECO-1. Reference samples were within a similar range. TOC levels in primary and reference samples for the 2013 sampling event are similar to those observed during the 2011 and 2012 sampling events. It is believed that TOC in samples is, largely, derived from decomposing plant material in marsh sediment.

Results of Benthic Macroinvertebrate Analysis - Based on the 2013 monitoring event, the number of unique taxa observed at each location (a measure of diversity) ranged from zero, at sample locations ECO-1 and ECO-5, to eight, at location ECO-4. Low taxa results were also reported at reference location ECO-RF1. Location ECO-5 displayed the lowest number of benthic macro-invertebrate taxa counted, similar to previous years. Oligochaetes (a common estuarine benthic organism) made up 62% of benthic organisms. Based on an assessment measure used to evaluate diversity of benthic organisms in the marsh surrounding the landfill (Shannon-Wiener Index of Diversity), most sample locations showed an increase in index value when compared to 2012, indicating a greater diversity species in 2013.

Results of Bioassay Tests - Toxicity testing was carried out on sediment samples collected in ECO-5 using the marine amphipod crustacean Leptocheirus plumulosus. Based on the 2013 monitoring event, the control sediment organism survival for the 10 day L. plumulosus test was 89%, just slightly below the recommended control survival of 90% or more. It was also determined that exposure to sediment from ECO-5 resulted in a L. plumulosus survival rate of 95%, an increase in survival of L. plumulosus compared to previous sampling events (2011 and 2012). Thus, the tests indicate that exposure to sediment from ECO-5 did not negatively impact the representative benthic organism during the monitoring event.

Site Inspection

The inspection of the site was conducted on November 24, 2014. The following parties were in attendance:

NJDEP – SRP Case Manager – Lynn Vogel
NJDEP- Solid Waste – Ram Shah
NJDEP- Eco Risk – Nancy Hamill
Global Consultant - Chris Hemingway (Golder)
Global Consultant – Frank Malinky (Golder)
Global Representative. – Rich Ricci (Lowenstein Sandler)
Global Representative- John Galasso (Alcatel-Lucent)

EPA Human Health Risk – Abbey States
EPA Hydrogeologist - Sharissa Singh
EPA Eco Risk – Mike Clemetson

The purpose of the inspection was to assess the protectiveness of the remedies, and the integrity of site including landfill capping, monitoring well conditions, leachate management and wetland restoration. The cap prevents direct exposure, and fencing restricts access to the site. There have been no changes in the physical conditions of the site that would affect the protectiveness of the remedy. The cap is in good repair. The gas, storm water, and leachate management systems appear to be operating properly and according to design.

Interviews

EPA maintains weekly contact with the NJDEP project manager to discuss the status of the site remediation. In addition, EPA conducted informal discussions with the Golder Associates project engineers during the site inspection tour.

Institutional Controls Verification

Classification Exception Area (CEA) –Effectiveness of the CEA will be certified by the PRP Group's contractor and will be submitted to NJDEP every two years after establishment. The CEA for both the UWZ and LWZ was updated in 2014 and is currently based on groundwater data and modelling of the 1,4-dioxane contamination, The CEA and the state classification of the UWZ at the site make the use of the groundwater in the vicinity of the site highly unlikely.

Deed Notices – In May 2015, the PRP Group had prepared the final deed notices and they will be sent to Middlesex County, New Jersey, for recording.

Technical Assessment

Question A: Is the remedy functioning as intended by the decision documents?

The implemented components of the remedy are currently functioning as stipulated in the OU1 ROD and ESD and the OU2 ROD. The remedy for the Global Sanitary Landfill site is based on the 1991 OU1 ROD and 2006 OU1 ESD that addresses landfill wastes and soil and the1997 OU2 ROD which addresses off-site groundwater, contaminated sediment, surface water contamination and wetlands area. The components of the OU1 remedy include capping of landfill; slope stability enhancement through construction of a soil stabilization berm; implementation of gas, storm water, and leachate management systems; installation of perimeter security fence to restrict access; and a monitoring program. The cap design, as specified in the 1991 ROD, was later modified to utilize geosynthetics and to reduce thickness as per the ESD of 2006.

The components of the OU2 remedy include water-quality sampling of on-site wells to monitor the extent of natural attenuation of contaminants with annual reviews to evaluate the need for further action; establishment of a CEA and WRA over the area of contaminated groundwater; localized removal of contaminated wetland sediments from the southeastern portion of the site and placement of these under cap; and annual ecological monitoring for five years after implementation of all remedial components.

These remedial activities were needed to achieve the remedial action objectives of preventing, reducing, or controlling the migration of contaminants from the landfill; protecting the potable

LWZ from contamination present in the UWZ; protecting the wetlands from contamination present in the UWZ; and preventing adverse ecological impacts from contaminated wetland sediments.

Construction of a landfill cap was completed in August 2012 along with other components of the remedy. Based on post-construction site inspections and O&M sampling data, it has been determined that the remedies had been constructed in accordance with plans specified in the OU1 and OU2 RDs. The cap is in good repair. The gas, storm water, and leachate management systems appear to be operating properly and according to design. The sediment restoration area was completed in 2011 and included excavation of existing sediment and replacement with coarse-grain soil to stabilize the area and promote establishment of wetland plants. The constructed soil berm remains stable.

Groundwater quality data from sampling in 2012 and 2013, from both the UWZ and LWZ, show that chemical constituent concentrations are consistent with those observed in pre-remedy monitoring. VOCs were detected above GWQS in the UWZ but were limited to 1,4-dioxane, which was consistently reported in most wells of the UWZ, and chlorobenzene and benzene, reported in several wells. Low levels of SVOCs were detected in all UWZ samples. VOCs were also detected in the LWZ above GWQS but at much lower levels with concentrations of TCE slightly above GWQS in several wells. Groundwater will continue to be collected and analyzed to evaluate contamination trends and attenuation in both water bearing zones.

The recent rounds of water-quality sampling indicate that levels of VOC contamination in the LWZ are relatively low compared to VOCs in the UWZ, likely because the lower aquifer is largely insulated from contaminated groundwater present in the UWZ due to the intervening clay-silt unit between the upper and lower aquifer units. However, the detection of 1,4-dioxane in LWZ wells suggests that 1,4-dioxane may migrate downward from the UWZ in the northern areas of the landfill where the confining unit is absent.

The presence and persistence of COCs in groundwater above GWQS required the establishment of a CEA for both the UWZ and LWZ and post-remedy groundwater monitoring. Based on groundwater monitoring results of 2012 and 2013, an updated CEA proposal was submitted to NJDEP and was approved by the Department in March of 2014. The CEA limit for both aquifer zones is based upon predicted spatial extent of 1,4-dioxane above GWQS. A CEA limit was established for the non-potable UWZ to the limits of the landfill cap because it serves as a potential source of contamination to the LWZ. The CEA limit for the LWZ is based on the predicted spatial extent of 1,4-dioxane above GWQS in the LWZ over time according to solute transport modeling, and is more extensive that the limit established for the UWZ. Although based on modelling, the LWZ is considered not potable in many areas downgradient of the site and is not being used for water supply. The effectiveness and spatial extent of the CEAs will need to be reviewed biannually and re-certified every two years following the establishment of the CEAs.

Results from recent ecological monitoring indicate that there is no evidence of adverse impacts to wetland sediments related to the landfill. The low-level concentrations of VOCs found in sediment samples is thought to be associated with natural occurrence or laboratory artifact. Monitoring indicates increasing growth of marsh vegetation in the sediment restoration area. The sandy, coarse-grain material originally used to support stabilization in the sediment restoration area is observed to be mixing with finer grain marsh sediments transported by tidal waters, facilitating vegetative growth and re-population of benthic community in the area.

Verified during a site visit on November 24, 2014, a well-maintained security fence restricts access to the site, and the remaining contamination present on-site is inaccessible due to the landfill cap. Access to contaminated groundwater remains limited by CEA, which was reapproved in March 2014. Therefore, exposure to site-related groundwater, soil, and sediment contamination during the monitored natural attenuation process is not anticipated.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy still valid?

Land use considerations used in the baseline human health risk assessment are still valid. The exposure assumptions and toxicity values that were used to estimate the potential risks and hazards to human health followed the general risk assessment practice at the time the risk assessments were performed for each OU. Although the risk assessment process has been updated and specific parameters and toxicity values may have changed, the risk assessment process that was used is still consistent with current practice and the need to implement a remedial action remains valid.

One potential exposure pathway that was not evaluated at the time of remedy selection is vapor intrusion. A development of single family homes was constructed 200 feet north of the landfill several years after the RODs were issued; however, the development is located upgradient of the UWZ plume. The maximum detected groundwater concentrations of benzene and chlorobenzene in upgradient wells exceeded screening levels determined by the OSWER Vapor Intrusion Screening Level (VISL) calculator (set at a cancer risk of 10^{-4} and HQ of 1). Since the site does not contain any buildings above the groundwater plume at this time and future development on the cap is prohibited, the vapor intrusion pathway is incomplete.

Ecological Risk Assessment - Results of the 1995 ecological risk assessment indicate potential risk to benthic macro invertebrates directly exposed to the leachate-contaminated sediments in the immediate vicinity of the leachate seep on the southeast side of the landfill. Ammonia, a leachate constituent, has been identified as the primary cause of potential toxicity. No other measurable risks are attributable to shallow groundwater.

Although the ecological risk assessment screening and toxicity values used to support the ROD may not necessarily reflect the current values, the excavation and capping eliminate any potential risk from surface soil contaminants to terrestrial receptors. The 2014 site groundwater and ecological monitoring report indicates that the ecological monitoring results do not indicate adverse impacts to the wetland sediments related to the landfill. The low-level concentrations of VOCs are not interpreted to be associated with the site and may be due to laboratory artifacts. Metals, ammonia, and benthic macroinvertebrate taxa results reported during this event are similar to results reported in reference samples.

The remedial action objectives used at the time of remedy selection are still valid. The objectives of the ongoing groundwater monitoring are to track groundwater quality in the UWZ and the perimeter of the landfill and to monitor the natural attenuation of contaminants in the LWZ. Several contaminants remain in excess of state and federal MCLs both in the source area UWZ and LWZ. There is no exposure via the direct pathway (ingestion as a potable water source) since there are no wells in the contaminated area and a CEA prevents future well installation. The aquifer's NJDEP IIIB classification also precludes the future use of the UWZ as a potable water source. Therefore, the remedy is protective even though groundwater exceeds drinking

water standards. Groundwater monitoring will ensure that concentrations continue to decrease and contamination is not migrating from the UWZ to the LWZ.

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

Based on the evaluation of the potential human and ecological exposures at the site there is no new information that could call into question the protectiveness of this remedy.

Technical Assessment Summary

Based on the data reviewed and the site inspection, the remedy is functioning as intended by the OU1 ROD, OU1 ESD and the OU2 ROD. The cap prevents direct exposure, and fencing restricts access to the site. There have been no changes in the physical conditions of the site that would affect the protectiveness of the remedy. The cap is in good repair. The gas, storm water, and leachate management systems appear to be operating properly and according to design. The sediment restoration area was completed in 2011 and included excavation of existing sediment and replacement with coarse-grain soil to stabilize the area and promote establishment of wetland plants. The constructed soil berm remains stable. Groundwater quality data from sampling in 2012 and 2013, from both the UWZ and LWZ, show results consistent with pre-remedy monitoring. Groundwater will continue to be monitored and contaminant trends and natural attenuation will be assessed. Currently, a CEA prevents unacceptable groundwater use in both the UWZ and LWZ. The CEA spatial extent and effectiveness will be evaluated annually.

Issues, Recommendations and Follow-Up Actions

Issues/Recommendations

OU(s) without Issues/Recommendations Identified in the Five-Year Review:
OU1
Issues and Recommendations Identified in the Five-Year Review:

OU(s): *OU2*	**Issue Category: Monitoring**			
	Issue: Since the OU 1 remedy was only completed in 2012 not enough post landfill cap construction groundwater monitoring data has been completed to establish contaminated groundwater trends.			
	Recommendation: Continue groundwater monitoring			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	No	PRP	State	6/1/2020

Protectiveness Statement(s)		
Operable Unit: 1	*Protectiveness Determination:* Protective	*Addendum Due Date (if applicable):*Click here to enter a date.
Protectiveness Statement: The remedy at OU1 is protective of human health and the environment.		

Protectiveness Statement(s)		
Operable Unit: 2	*Protectiveness Determination:* Short-term Protective	*Addendum Due Date (if applicable):*Click here to enter a date.
The remedy at OU2 currently protects human health and the environment because all human and ecological exposure routes have been addressed. However, in order for the remedy to be protective in the long-term, the trends from additional rounds of data will need to be evaluated to ensure that the groundwater contamination in the LWZ is responding as expected to the completion of the cap.		

Sitewide Protectiveness Statement	
Protectiveness Determination: Short-term Protective	*Addendum Due Date (if applicable):* Click here to enter a date.
Protectiveness Statement: The remedy at the site is protective of human health and the environment in the short-term because all human and ecological exposure routes have been addressed. However, in order for the remedy to be protective in the long-term, trends developed from additional rounds of groundwater sampling data will need to be evaluated to ensure that the groundwater contamination is responding to natural attenuation as expected with the completion of the landfill cap construction.	

Next Review

The next five-year review report for the Global Sanitary Landfill Superfund site is required five years from the completion date of this review which shall be July 2020.

Tables

Table 1: Chronology of Site Events

Event	Date(s)
Initial discovery of problem or contamination	1984
Pre-NPL responses - NJDEP order to cease operations	4/27/84
Final NPL listing	3/3/89
OU1 FS complete	2/19/91
OU1ROD signature	9/11/91
OU1 Consent Decree	11/15/93
OU1 Remedial design start	1993
OU2 RI/FS complete	1996
OU2 ROD signature	09/29/97
OU1 Explanation of Significant Differences	8/15/06
Amended OU1 and OU2 CD	9/18/2008
OU1 and OU2 Remedial design complete	9/2009
OU1 and OU2 On-site remedial action construction start	8/2010
OU1 and OU2 On-site remedial action completion	8/20/12
Construction completion date	1/16/2014
OU1 and OU2 RA construction completion	04/04/14
Final Close-out Report (if applicable)	TBD
Deletion from NPL (if applicable)	TBD
Previous five-year reviews	n/a

Table 2: Documents, Data and Information Reviewed in Completing the Five-Year Review

Document Title, Author	Submittal Date
OU1 ROD, EPA	9/11/91
OU2 ROD, EPA	9/29/97
ESD for OU1 ROD, EPA	8/15/06
Final 100% design document, PRP/Golder	10/07
Final 100% design addendum, PRP/Golder	3/09
Fact Sheets prepared by EPA and also the PRP's	2010 -
Remedial Action Report, PRP/Golder	9/13/13
Operation & Maintenance Plan, PRP/Golder	4/13
2012 Annual Groundwater and Ecological Monitoring Report, PRP/Golder	3/13
2013 Annual Groundwater and Ecological Monitoring Report, PRP/Golder	4/14

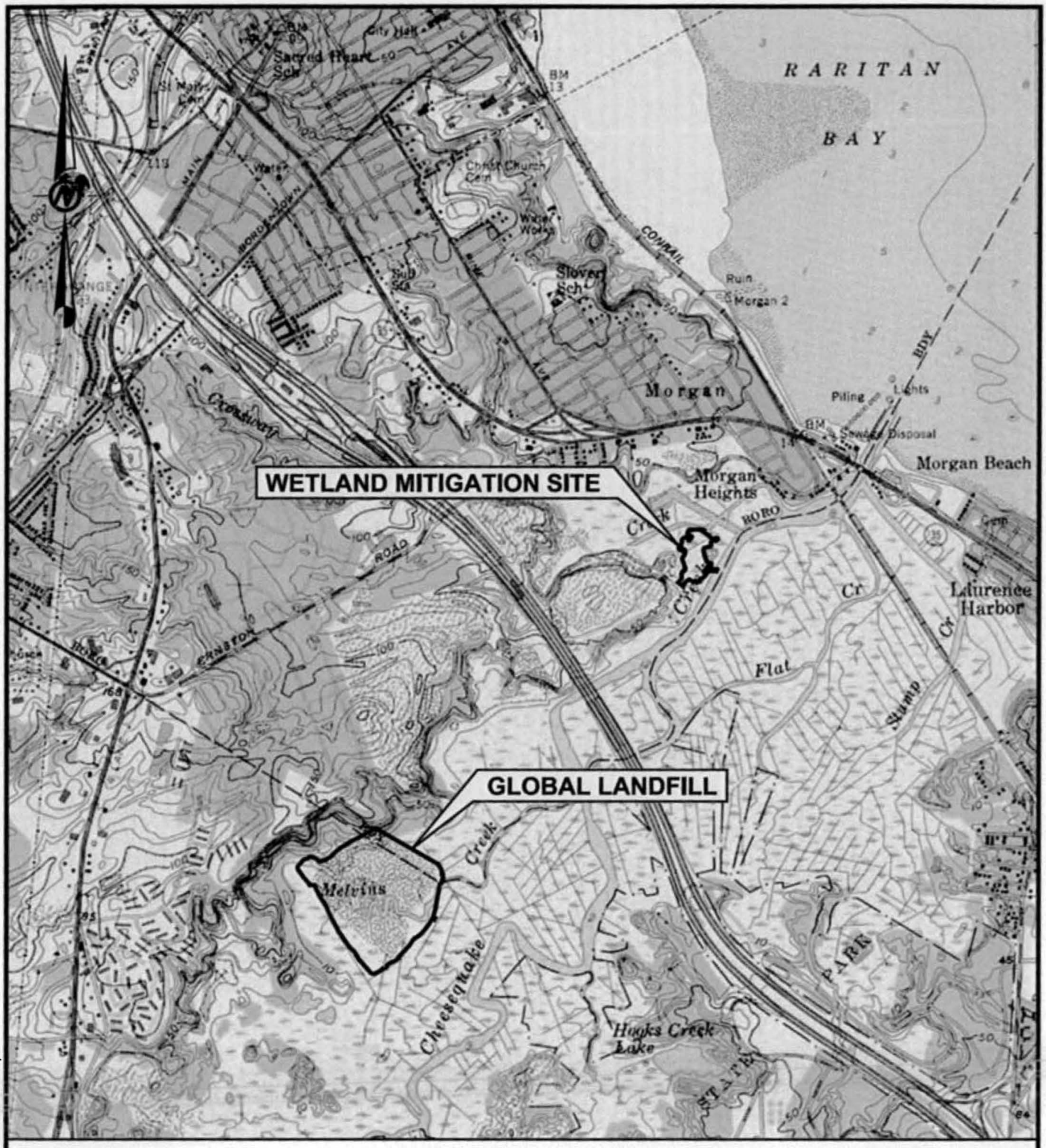
Attachments

Attachment 1: Figures

Figure 1 Site Location Map

Figure B-1 Classification Exception Area Limits

Attachment 2: Data



REFERENCE

1.) MAP TAKEN FROM U.S.G.S. 7.5 MINUTE QUADRANGLE OF SOUTH AMBOY, NEW JERSEY, DATED 1981.

2000 0 2000
SCALE FEET

NJ Authorization #24GA28029100

Golder Associates
Newark New Jersey

FILE No.	9436183ZP05
PROJECT No.	943-6183
REV.	0

SCALE	AS SHOWN
DATE	02/15/13
DESIGN	WAH
CADD	RG
CHECK	WAH
REVIEW	FTA

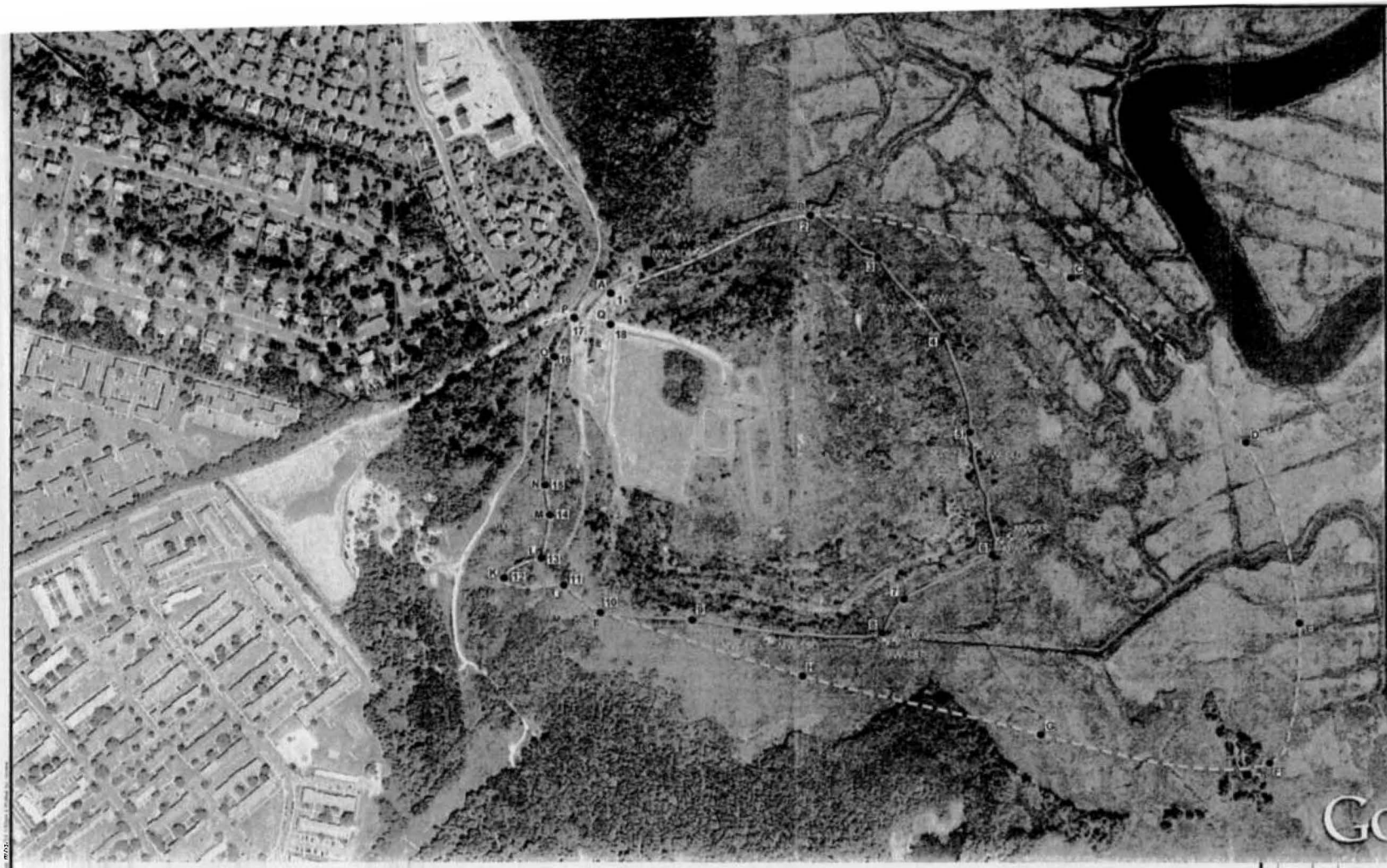
TITLE

SITE LOCATION MAP

GLOBAL LANDFILL WETLAND MITIGATION SITE

FIGURE 1

Drawing file: 9436183ZP05.dwg Feb 15, 2013 -- 2:18pm



UWZ CEA LIMIT COORDINATES		
ID	NORTHING	EASTING
1	588444.52	2106537.61
2	587978.21	2107238.66
3	587666.22	2107254.35
4	587284.5	2107161.17
5	586985.58	2106914.62
6	586637.51	2106569.15
7	586820.96	2106228.37
8	586818.2	2106070.11
9	587455.29	2105682.47
10	587765.21	2105499.75
11	587944.25	2105504.94
12	588150.01	2105393.82
13	588077.38	2105539.79
14	588147.17	2105697.37
15	588230.3	2105783.65
16	588488.72	2106213.34
17	588508.79	2106379.05
18	588377.23	2106441.17

LWZ CEA LIMIT COORDINATES		
ID	NORTHING	EASTING
A	588444.52	2106537.61
B	587978.21	2107238.66
C	587002.67	2107631.03
D	586092.16	2107504.04
E	585502.3	2107042.45
F	585283.46	2106521.94
G	586077.15	2106101.07
H	586976.25	2105751.98
I	587765.21	2105499.75
J	587944.25	2105504.94
K	588150.01	2105393.82
L	588077.38	2105539.79
M	588147.17	2105697.37
N	588230.3	2105783.65
O	588488.72	2106213.34
P	588508.79	2106379.05
Q	588377.23	2106441.17

LEGEND

APPROXIMATE LIMIT OF UWZ CEA BOUNDARY

APPROXIMATE LIMIT OF LWZ CEA BOUNDARY

MW-01 GROUNDWATER MONITORING WELL NETWORK

NOTE

1.) COORDINATES SHOWN REFERENCE THE NEW JERSEY STATE PLANE NAD 27 COORDINATE SYSTEM.

REFERENCES

1.) AERIAL PHOTOGRAPH LICENSED FROM GOOGLE EARTH PRO.

2.) MONITORING WELL LOCATIONS SURVEYED BY JAMES M. STEWART, INC. OF PHILADELPHIA, PA. MAY, 2004.

3.) MONITORING WELL MW-68 TAKEN FROM ELECTRONIC FILE Final Downgradient Plan - UPDATED 020108.dgn, ENTITLED "FINAL DEVELOPMENT PLAN - SHEET 4 OF 4," PREPARED BY LAYOUT INC., DATED NOVEMBER 29, 2012.

200 0 200 400
APPROXIMATE SCALE FEET

REV	DATE	DES	REVISION DESCRIPTION	CHKD	CHK	APP

PROJECT

GLOBAL LANDFILL
REMEDIAL ACTION REPORT
TOWNSHIP OF OLD BRIDGE, MIDDLESEX COUNTY, NJ

TITLE

CLASSIFICATION EXCEPTION AREA LIMITS

Golder Associates
Mt. Laurel, New Jersey

PROJECT No.	043-8153	FILE No.	843815320R0
DESIGN	TDS	03/13/13	SCALE AS SHOWN REV. 0
CADD	RG	03/13/13	
CHECK			
REVIEW			

FIGURE B-1

TABLE 1
GLOBAL LANDFILL
CONTAMINANT CONCENTRATIONS IN GROUND WATER
BASED ON 1991 RI DATA

PARAMETER	TYPE			UWZ Average Detected Concentration	UWZ Maximum Detected Concentration	LWZ Detected Concentration in MW5D	Ground - Water Quality Criteria
Acetone	VOC			107	290		700
Carbon Disulfide	VOC			9	23		800
Benzene	VOC	TTO	TVOS	47	200	5	0.2
2 - Hexanone	VOC			61	61		
Toluene	VOC	TTO		4	7	2	1,000
Chlorobenzene	VOC	TTO		755	5,300	150	50
Ethylbenzene	VOC	TTO		43	120		700
Total Xylenes	VOC			112	440		1,000
Vinyl Chloride	VOC	TTO				3	0.08
1,2 - Dichloroethene (Total)	VOC	TTO				6	70
Trichloroethene	VOC	TTO	TVOS			6	1
TOTAL TVOS	VOC	TTO	TVOS	47	200	11(0.0002 lb/hr)	
Phenol	SEMI	TTO		34	34		4,000
1,4 - Dichlorobenzene	SEMI	TTO		11	17		75
1,2 - Dichlorobenzene	SEMI	TTO		2	2		600
Bis(2 - Chloroisopropyl)ether	SEMI	TTO		2	2		300
Isophorone	SEMI	TTO		3	3		100
2,4 - Dimethylphenol	SEMI	TTO		47	79		100
Naphthalene	SEMI	TTO		167	900		300
2 - Methylnaphthalene	SEMI			33	61		
Acenaphthene	SEMI	TTO		24	82		400
Anthracene	SEMI	TTO		2	5		2,000
Dibenzofuran	SEMI			17	47		
Fluorene	SEMI	TTO		4	6		300
n - Nitrosodiphenylamine	SEMI	TTO		50	50		7
Phenenthrene	SEMI	TTO		19	48		
Di - n - butylphthalate	SEMI	TTO		1	1		
Fluoranthene	SEMI	TTO		3	7		300
Pyrene	SEMI	TTO		0.7	1		200
Bis(2 - Ethylhexyl)phthalate	SEMI	TTO		6	15	8	3
Di - n - octylphthalate	SEMI	TTO		0.8	0.8		100
Benzoic Acid	SEMI					5	
delta - BHC	PEST	TTO		0.116	0.18		
gamma - BHC (Lindane)	PEST	TTO		0.054	0.054		0.2
Aldrin	PEST	TTO		0.761	1.9		0.002
Dieldrin	PEST	TTO		0.14	0.14		0.002
4,4' - DDE	PEST	TTO		0.121	0.15		0.1
alpha - Chlordane	PEST	TTO		0.096	0.096		0.01
gamma - Chlordane	PEST	TTO		0.24	0.32		0.01
Aroclor - 1242	PCB	TTO		10	10		0.02
Aroclor - 1248	PCB	TTO		21	22		0.02
Aroclor - 1254	PCB	TTO		4	3.7		0.02
TOTAL PCBs	PCB	TTO		34	35.7		0.02
TOTAL TTO (4)		TTO		1,600	7,840	188	
Aluminum	MET			1,036	3,240	1,560	200
Antimony	MET			30	34		2
Arsenic	MET			9	29		0.02
Barium	MET			294	811	132	2,000
Beryllium	MET			2	2		0.008
Cadmium	MET			1	2		4
Calcium	MET			62,069	145,000	5,860	
Chromium	MET			38	112		100
Cobalt	MET			41	180	38	
Copper	MET			19	39		1,000
Iron	MET			15,966	48,800	5,330	300
Lead	MET			14	125	2	5
Magnesium	MET			66,103	224,000	3,100	

TABLE 1 (continued)
GLOBAL LANDFILL
CONTAMINANT CONCENTRATIONS IN GROUND WATER
BASED ON 1991 RI DATA

PARAMETER	TYPE	UWZ Average Detected Concentration	UWZ Maximum Detected Concentration	LWZ Detected Concentration in MW5D	Ground - Water Quality Criteria
Manganese	MET	754	2,960	374	50
Mercury	MET	0.54	0.87		2
Nickel	MET	70	197	41.1	100
Potassium	MET	200,505	692,000	3,670	
Selenium	MET	5	11		50
Sodium	MET	985,918	3,010,000	29,700	50,000
Vanadium	MET	15	33		
Zinc	MET	158	343	219	5,000
Cyanide	MISC	29	92		200
Ammonia, as N (ppm)	MISC	258	924	1.61	0.5
BOD 5 (ppm)	MISC	33	74	45	
Chloride (ppm)	MISC	2,009	6,810	91.7	250
COD (ppm)	MISC	519	1,410		
Cr-Hex (ppb)	MISC	27	290		
MBAS (ppm)	MISC	0.44	1.15		0.5
NO3-NO2 (ppm)	MISC	1	1.39		10
Sulfate (ppm)	MISC	61	115		250
TDS (ppm)	MISC	3,682	9,950	187	500
TOC (ppm)	MISC	250	938	2.2	
Total Phenols (ppb)	MISC	93	416		
pH	MISC	5.99	6.6	5.31	6.5-8.5
Specific Conductivity (µmho)	MISC	8,759	20,000	268	

NOTES 1. All concentrations are in µg/L (ppb) except where noted otherwise.
2. Average concentration is based on detects not including reanalyses or duplicates unless analyte is not detected in the primary sample.
3. Maximum concentration is based on all detections including reanalyses and duplicates.
4. Organics not elsewhere individually limited are included in the limitation for TTO.

UWZ - Upper Water - bearing Zone
LWZ - Lower Water - bearing Zone
- Exceeds most stringent ground-water quality criteria (i.e., N.J.A.C. 7:9-6 Ground Water Quality Standards for Class II-A Ground Waters (April 19, 1993), EPA 822-R-94-001 for Federal MCLs, or N.J.A.C. 7:10 for New Jersey MCLs. Revised New Jersey MCLs have been published in the New Jersey Register of 11/18/96 for the folowing chemicals and are included as Interim Specific Criteria Carbon disulfide, chlorobenzene, total xylenes, 1,2 - dichloroethene, and naphthalene).
MCL - Maximum Contaminant Limit
TVOS - Total Toxic Volatile Organic Substances
TTO - Total Toxic Organics
VOC - Volatile Organic Compound
SEMI - Semivolatile Organic Compound
PEST - Pesticide
PCB - Polychlorinated Biphenyl
MET - Metal
MISC - Miscellaneous parameter

Reference: URS Consultants,Inc., March 1995. "Task 7 (Phase III FS): Final Feasibility Study at the Global Landfill Site, Old Bridge Township, Middlesex County , New Jersey"
Table 1 - 1